REMARKS

Claims 1-59 are pending in the present application. Applicant notes that in the Office Action dated June 16, 2004, claims 1-36, 41 and 48-59 were listed as withdrawn from consideration. In the Preliminary Amendment filed with the application, claims 1-36, 41 and 48 -59 were cancelled. The listing of the claims starting on page 2 accurately lists these claims as cancelled. New claims 60-68 have been added. Claim 39 has been cancelled. In this amendment claims 37, 40, and 45 have been amended.

In the Office Action dated June 16, 2004, the Examiner rejected claims 37-39, 42 and 45-47 under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,074,288 to Nagahara et al. ("Nagahara"). Claim 40 was rejected under 35 U.S.C. 103(a) as being unpatentable over the Nagahara reference in view of U.S. Patent No. 5,499,316 to Strasbaugh ("Strasbaugh"). Claim 44 was rejected under 35 U.S.C. 103(a) as being unpatentable over the Nagahara reference in view of the Strasbaugh reference and in further view of U.S. Patent No. 6,022,268 to Roberts et al. ("Roberts"). Claim 43 was rejected under 35 U.S.C. 103(a) as being unpatentable over the Nagahara reference in view of the Strasbaugh reference and the Roberts reference and in further view of U.S. Patent No. 6,439,967 B2 to Carpenter ("Carpenter").

Embodiments Disclosed in the Present Application

The disclosed embodiments of the present application will now be discussed in comparison to the cited references. Of course, the discussion of the disclosed embodiments, and the discussion of the differences between the disclosed embodiments and the cited references do not define the scope or interpretation of any of the claims. Instead, such discussed differences merely help the Examiner appreciate important claim distinctions discussed thereafter.

The present application is directed towards methods and apparatuses for planarizing microelectronic substrates. In an embodiment, as shown in Figure 6 of the present application, a membrane 250 is positioned within a substrate holder 231 that retains a substrate 112 while the substrate is planarized. The membrane 250 includes a peripheral portion 251 that may have a thickness greater than the central portion 252. The membrane 250 may include two plies 253 of compressible material, shown as an upper ply 253a and a lower ply 253b. The upper

ply 253a may have a generally circular shape and the lower ply 253b may have a generally annular shape with a central opening facilitating rapid alteration of the cross-section of the membrane 250. Alternatively, in other embodiments, such as the embodiment disclosed in Figure 5, the peripheral portion 251 may have a thickness that is thinner than the central portion 252. In either case, the membrane may be fabricated from a generally flexible, compressible solid material, which may be comprised of neoprene or a silicone rubber, although other resilient, flexible and compressible materials may be also used to fabricate the membrane.

When the substrate 112 is undergoing planarization, the substrate holder 231 and the membrane 250 apply downward forces onto the substrate 112 to force the substrate 112 against a planarization pad (not shown in Figure 6). The relatively thicker portions of the membrane 250 correspondingly exert a greater force on portions of the substrate 112 that contact the thicker portions of the membrane 250, while the relatively thinner portions of the membrane 250 exert a lesser force on other portions of the substrate 112. Consequently, the portions of the substrate 112 subjected to the greater normal force are planarized at a greater rate than the portions of the substrate 112 that are in facial contact with the thinner portions of the membrane 250. In one embodiment, when the thicker portions of the membrane 250 are positioned in the peripheral portion 251 of the membrane 250, substrates 112 having features toward the periphery of the substrate 112 that require higher planarization rates are more effectively planarized since the additional normal force presented by the peripheral portion 251 allows the substrate periphery to be planarized at a greater rate than is achievable by the greater linear velocity at the periphery of the substrate 112 alone. This embodiment is particularly suitable if the peripheral region of the substrate 112 includes features that exhibit a higher hardness than the other regions of the substrate 112.

Cited References

The Examiner has cited the Nagahara reference. The Nagahara reference is directed toward solving the problem of center slowing that occurs when polishing substrates. Center slowing refers to the condition where the material removal rate at a center region of the substrate during polishing is slower relative to a material removal rate at the periphery of the substrate. In order to reduce the nonuniform material removal rates during polishing, the

Nagahara reference employs a carrier film 114 that includes a base layer 110 disposed between a pressure sensitive adhesive layer 108 and a porous layer 112 (See, Figure 2). The porous layer 112 has a protruding dome shape configured to contact a center region of a substrate. The porous layer 112 is formed on the base layer 110 to have a substantially uniform thickness followed by machining to define the shape of the protruding dome. Thus, the porous layer 112 is formed of a unitary layer. As depicted in Figure 3, the pressure sensitive adhesive layer 108 of the carrier film 114 is affixed to a backing plate 104 of a substrate holder assembly 100. A substrate 20, which will ultimately be polished, is positioned to contact the protruding dome shape of the porous layer 112 and is retained on the substrate holder assembly 100 by a circumferential restraint member 106. During chemical mechanical polishing (CMP), a shaft 102 lowers the substrate holder 100 so that the substrate 20 contacts a polishing pad 22. An actuator or motor connected to the shaft 104 rotates the substrate holder assembly 100 including the substrate 20 in order to effect polishing of the substrate 20. The protruding dome of the porous layer 112 applies pressure on a center area of a surface of the substrate 20 to alleviate the problem of center slowing that would ordinarily occur during CMP. Thus, the protruding dome of the porous layer 112 "applies pressure on a center area of a substrate surface, which may be underpolished in a conventional substrate holder assembly if center slow polishing conditions have set in." (Nagahara reference, Column 7, lines. 24-28).

While the Nagahara reference provides a solution to the problem of center slowing that results during conventional CMP, it does not disclose or fairly suggest a carrier film having a configuration for enhancing the material removal rate in a peripheral region of the substrate 20. Furthermore, the Nagahara reference forms the porous layer 112 from a single piece of polymeric material and, thus, does not disclose or fairly suggest forming the porous layer 112 from more than one ply of a membrane material.

The Examiner has also cited the Strasbaugh reference. The Strasbaugh reference is directed toward a wafer carrier for planarizing a wafer. Referring to Figure 5, the carrier includes a membrane 40 that contacts the back surface of wafer 10. When the wafer 10 is being polished, a pressurized fluid is communicated to a floating piston 40 to cause the membrane 40 to bear against the back surface of the wafer 10. The pressure applied to the wafer 10 through the membrane 40 is uniform across the wafer to effect uniform removal of material.

The Roberts reference has also been cited by the Examiner for the purposes of disclosing an injection molding process for polishing pads. Although the Roberts reference discloses injection molding polishing pads, it does not disclose or fairly suggest injection molding a membrane for a substrate holder.

The Examiner has also cited the Carpenter reference. In view of the provisions of 35 U.S.C. 103(c), the Carpenter reference may not be used as a reference in a rejection under 35 U.S.C. 103(a). The Carpenter reference may not be properly used in a 35 U.S.C. 103(a) rejection because it is a reference under 35 U.S.C. 102(e)(2) and the Carpenter reference and the present application were commonly owned by Micron Technology Inc. at the time the present invention was made. Accordingly, the Carpenter reference is disqualified as a reference under 35 U.S.C. 103(a) in view 35 U.S.C. 103(c).

The Claims and Rejections

Turning now to the claims, the patentably distinct differences between the cited references and the claim language will be specifically pointed out. Presently amended independent claim 37 recites, in part, "biasing the microelectronic substrate against a planarizing medium with a flexible membrane to exert a first force on a first part of the microelectronic substrate and exert a second force greater than the first force on a second part of the microelectronic substrate, *the second part located in a peripheral region of the microelectronic substrate and the first part located in a region of the microelectronic substrate outside of the peripheral region.*" (Emphasis Added). The Nagahara reference does not disclose or fairly suggest the above limitations. In fact, as alluded to above, the Nagahara reference teaches away from such a limitation by disclosing applying a greater force to the center region of a substrate to alleviate the problem of center slowing. In contrast, presently amended independent claim 37 requires biasing the second part of the microelectronic substrate located in a peripheral region thereof with a force greater than a force that biases a first part of the microelectronic substrate located in a region outside the peripheral region. Therefore, presently amended independent claim 37 is allowable over the Nagahara reference.

Claims depending from claim 37 are also allowable due to depending from an allowable base claim and further in view of the additional limitations recited in the dependent

claims. For example, dependent claim 45 also includes subject matter patentable over the Nagahara reference. Specifically, the Nagahara reference does not disclose or fairly suggest "forming the membrane by providing a first ply of a membrane material at a first and second portions of the membrane and attaching a second ply of the membrane material to the first ply at the second portion of the membrane." The Nagahara reference discloses that the porous layer 112 is formed of a unitary layer of material. As alluded to above, the porous layer 112 is formed on the base layer 110 to have a substantially uniform thickness followed by machining to define the shape of the protruding dome. The Nagahara reference does not disclose or fairly suggest forming the porous layer 112 from more than one ply of membrane material as required by the limitations of dependent claim 45. The configuration for the membrane recited in claim 45 facilitates varying the normal force applied to the microelectronic substrate. Claim 45 has also been amended to correct a problem with a lack of proper antecedent basis for the elements first and second portions of the membrane and does not alter the scope of the claim.

Dependent claim 45 has also been re-written in independent form as independent claim 60 to include the limitations of former independent claim 37. As discussed above, dependent claim 45 is patentable over the Nagahara reference and, thus, is patentable over the Nagahara reference when re-written in independent form. New dependent claims 61-68 have also been added.

All of the claims remaining in the application (claims 37-38, 40, 42-47, and 60-68) are now clearly allowable. Favorable consideration and a timely Notice of Allowance are earnestly solicited.

Respectfully submitted,

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